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Question Paper Code : 60057

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

Second Semester

Computer Science and Engineering

PH 3256 — PHYSICS FOR INFORMATION SCIENCE

(Common to : B.E. Computer and Communication Engineering/ B.Tech. Artificial Intelligence and Data Science/B.Tech. Computer Science and Business Systems/B.Tech. Information Technology)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the postulates of classical free electron theory?

2. Define mobility of electrons.

3. What are direct and indirect bandgap semiconductors? Give examples.

4. The phosphorous doping in Si causes the Fermi level to lie 0.3 eV above the intrinsic Fermi level. Calculate the electron and hole concentration at 300 K. Assume intrinsic carrier concentration as 1.6×10^{16} atoms m^{-3}.

5. A paramagnetic material has a magnetic field intensity of $10^4 Am^{-1}$. If the susceptibility of the material at room temperature is 3.7×10^{-3}. Calculate the magnetization and flux density of the material.

6. Give examples of hard and soft magnetic materials.

7. What is the principle of solar cell?

8. How are optical materials classified?

9. How are qubits stored?

10. What does the Bloch sphere represent?

PART B — (5 × 16 = 80 marks)

11. (a) Derive an expression for electrical conductivity of a material in terms of mobility of electrons and hence obtain Wiedemann-Franz law. (16)

Or

(b) Write short notes on the following :

(i) Fermi Dirac distribution (6)

(ii) Fermi energy at T = 0K and T > 0K (6)

(iii) Significance of Fermi energy (4)

12. (a) (i) Discuss with necessary theory the variation of fermi level with temperature in intrinsic semiconductor. (12)

(ii) Find the intrinsic carrier concentration and position of the intrinsic Fermi level in Si with respect to the VB edge. Assume $m_h^* = 0.92 m_0$, $m_e^* = 0.49 m_o$, $N_c = 2.21 \times 10^{25} m^{-3}$, $N_v = 8.60 \times 10^{24} m^{-3}$, $T = 300\text{K}$. (4)

Or

(b) Explain the working characteristics, applications and limitations of Schottky diodes. (16)

13. (a) What is an antiferromagnetic material? Explain the antiparallel alignment of dipoles in antiferromagnetic material with suitable sketch and hence derive an expression for the susceptibility of an antiferromagnetic material. (16)

Or

(b) Explain in detail the process of data storage in magnetic hard discs. (16)

14. (a) Explain with neat sketch the principle working and applications of organic LEDs. (16)

Or

(b) Discuss the construction and working of a laser diode. (16)

15. (a) (i) What are the conditions for quantum confinement to occur? (8)

(ii) Discuss in detail the different types of quantum structures. (8)

Or

(b) (i) How does a CNOT gate work? (6)

(ii) What is coulomb blockade effect in nanomaterials? (6)

(iii) What is the difference between tunnel diode and normal diode? (4)